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ADVANCED ANALYSIS OF THE INFLUENCE OF CLOUDS, PRECIPIATION AND SURFACE EMISSIVITY ON DMSP/NPOESS SATELLITE MICROWAVE CHANNELS

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Final Report

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13. ABSTRACT *(Maximum 200 words)*

This contract was for a basic research program to investigate the effects of clouds, precipitation and surface emissivity on microwave satellite sensors and their influence on atmospheric retrievals using the Unified Retrieval (UR) technique. The work consisted of the following tasks: development of databases of brightness temperatures from various satellite sensors; development databases of conventional analysis to verify the presence and amount of clouds and precipitation and for verification of retrieval results; the application of the UR techniques to the satellite sensor data; and the assessment of the accuracy of UR techniques in the presence of clouds.There was no measurable decrease in the UR performance in non-precipitating cloud cases. In cases with precipitating clouds, the UR performance was degraded as measured by the residual, which increased with increasing rain rate within the FOV.

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P689

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ATTN: Vincent Falcone

Subject: Contract F19628-96-C-0108
Final Letter Report

1. This is the final Summary Letter Report under the referenced contract. This Letter Report is submitted, as required, in lieu of the CDRL requirements when the contract was "descoped" in 2001 in a contract modification letter dated 27 February 2001.

2. Program Summary

The contract was for a basic research program to investigate the effects of clouds, precipitation and surface emissivity on microwave satellite sensors and their influence on atmospheric retrievals using the Unified Retrieval (UR) technique. The work consisted of the following tasks: development of databases of brightness temperatures from various satellite sensors; development databases of conventional analyses to verify the presence and amount of clouds and precipitation and for verification of retrieval results; the application of the UR technique to the satellite sensor data; and the assessment of the accuracy of UR technique in the presence of clouds.

3. Summary of Accomplishments

3.1. Implementation and Enhancements of Computer Codes

The set of microwave Unified Retrieval (UR) codes developed at Atmospheric and Environmental Research, Inc. (AER) was ported over to the designated computer system at AFRL/Hanscom AFB. This set of codes was the primary analysis tool used in the study.

A set of software was developed, to run on a UNIX platform, to read data from SEASPACE Terascan system. The Terascan provided the primary source of satellite data.

A set of special graphics programs were created to analyze the residual errors, i.e. the difference between the actual observed brightness temperature and the brightness temperature computed using the atmospheric profiles retrieved by application of the UR technique.

Created software to merge the data from F-11 microwave sensor suite consisting of SSM/I, SSM/T-1, and SSM/T-2.

Created graphics programs to examine atmospheric profiles and surface characteristics generated from the application of the UR technique.

Created graphics programs to examine the merged microwave data, which included EDR's (Environmental Data Records), such as total precipitable water, surface temperature, and rain rate, based on SSM/I brightness temperatures alone.

Enhanced the UR system for the infrared channels of the GOES-8 Sounder.

3.2. Case Selection and Databases

Eleven ocean cases, from the August to September 1995 timeframe were selected for analysis. The set of F-11 microwave suites (SSM/I, SSM/T-1, and SMM/T-2) and GOES-8 sounder data for these cases were assembled into workable databases. The corresponding conventional data for these cases were assembled. These conventional data sets were primarily drawn from LFM data fields and included temperature, mixing ratio for the mandatory pressure levels, and surface air temperature. In addition, a dataset of DMSP microwave data were also assembled for validation purposes.

3.3. Analyses

Not all of the data sets were used in the de-scoped effort. The following provides a summary of the analyses completed under the revised effort.

The UR technique was applied to the selected cases, with and without precipitating clouds.

The results for non-precipitating cloud cases were examined with respect to clouds (determined from the AFWA cloud analysis routines and cloud liquid water retrieval based on co-located SSM/I brightness temperatures).

For the precipitating cloud cases, the UR outputs were also examined with respect to precipitation determined from the SSM/T-2 threshold algorithm and from the precipitation algorithm based on co-located SSM/I brightness temperatures.

3.4. Conclusions

There was no measurable decrease in the UR performance in non-precipitating cloud cases.

In cases with precipitating clouds, the UR performance was degraded as measured by the residual, which increased with increasing rain rate within the FOV.

Submitted by

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cc: Jenny Zhu - AER
P689 file